REPORT DOCUMENTATION PAGE

AFRL-SR-BL-TR-00-

0640

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
		1 July 1997 - 31 March 1998

4. TITLE AND SUBTITLE
IUTAM Symposium on Computational Methods for UnBound Domains

5. FUNDING NUMBERS
F49620-97-1-0397

6. AUTHOR(S)
Professor Thomas Geers

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
University of Colorado
Department of Mechanical Engineering
Boulder, CO 80309-0427

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
AFOSR
801 North Randolph Street, Room 732
Arlington, VA 22203-1977

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
F49620-97-1-0397

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for Public Release.

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

The symposium was regarded by all as a resounding success. Disciplinary and semantic barriers were pushed aside as lively discussions accompanied the presentations. About two-thirds of the papers focused on the classical wave equation of acoustics, as this is the simplest governing equation of the types considered. However, three papers dealt with hydrodynamic surface waves, two with electromagnetic waves, three with elastodynamic waves, and four with waves in aerodynamics. Approximately two-thirds of the papers addressed steady-state problems, with the rest treating problems in the time domain. A key unifying aspect of the symposium was the creation of four working groups that labored in parallel to fomulate benchmark problems for evaluating computational boundaries. The working groups reviewed the papers presented each day, searching for benchmark candidates. Then they considered other possibilites and organized the ensemble into logical categories. At the end of the symposium, each group presented its benchmark candidates to the assembly of participants, which subsequently made a first cut at consolidating the benchmarks.

14. SUBJECT TERMS	15. NUMBER OF PAGES
	3
	16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

Domineck Darnelle Civ AFRL/AFOSR

From: Thomas L. Geers [geers@spot.colorado.edu]
Sent: Thursday, November 16, 2000 8:19 PM
To: darnelle.domineck@afosr.af.mil
Subject: REPORT FOR F49620-97-1-0397

Ms. Domineck: Please see the stuff below. Tom Geers

>Date: Tue, 9 Mar 99 7:53:50 EST
>X-Priority: 3 (Normal)
>To: <geers@spot.colorado.edu>
>From: Arje Nachman <arje.nachman@afosr.af.mil>
>Reply-To: <arje.nachman@afosr.af.mil>
>Subject: re: REPORT FOR F49620-97-1-0397
>X-Incognito-SN: 789
>X-Incognito-Version: 4.11.23
>MIME-Version: 1.0
>Status:
>
>Thanks for the Final Report. I would indeed appreciate a copy of the
>proceedings. Thank you.
>
>Dr. Arje Nachman
>AFOSR/NM
>801 North Randolph
>Rm 732
>Arlington, VA 22203-1977
>(703)696 8427 FAX(703)696 8450

>----------

>Original Text
>From: Thomas L. Geers <geers@spot.colorado.edu>, on 3/8/99 6:53 PM:
>Dear Dr. Nachman:
>
>Since Mark Ablowitz forwarded your e-mail to me, I've been poking our
>Office of Contracts and Grants. Jan Farrar in that office has told me that
>my e-mail report to you on 26 December 1997 should have sufficed and that
>your system should know about it if you forwarded a copy with your approval
>to Jennifer Bell, your contract person at 767-6836. Below is a copy of the
>report that I e-mailed you on 12/26/97. If it is not sufficient, please
>let me know.
>
>Although I don't see anything in the contract regarding the bound symposium
>proceedings, I presume that you would be interested in receiving a couple
>of copies. If so, please reply with your snail-mail address.
>
>Thanks again for your support of the symposium.
>
>Tom Geers
>
>***
>
>Symposium Report (IUTAM 97-11)
>Thomas L. Geers, Ph.D.
>University of Colorado
>Boulder, CO 80309, USA
>geers@spot.colorado.edu
>

>IUTAM SYMPOSIUM ON COMPUTATIONAL
>METHODS FOR UNBOUNDED DOMAINS
>
>27-31 July 1997, University of Colorado, Boulder, CO
>
>Thirty-seven researchers in acoustics, aeronautics, elastodynamics,
>electromagnetics, hydrodynamics and mathematics participated in this
>interdisciplinary symposium. The participants represented twelve
>countries, as follows: Belgium (1), Canada (1), France (1), Germany (1),
>Greece (1), Israel (2), Japan (1), New Zealand (2), Sweden (1), Switzerland
>(3), United Kingdom (2), United States of America (21). Eight of the
>participants were young investigators invited by members of the Advisory
>and Scientific Committees.
>
>
>Committees
>----------
>
>Initially, an Advisory Committee was formed to prepare the IUTAM symposium
>proposal. The members of this committee are
>
>T.L. Geers, Chairman, University of Colorado, USA
>J. Bielak, Carnegie Mellon University, USA
>D. Givoli, Rensselaer Polytechnic University, USA (visiting from Israel)
>P.M. Pinsky, Stanford University, USA
>
>The members of the IUTAM Scientific Committee are
>
>T.L. Geers, Chairman, University of Colorado, USA
>R.J. Astley, University of Canterbury, New Zealand
>G.A. Athanassoulis, Nat'l Tech. Univ. of Athens, Greece
>P. Bettess, University of Durham, UK
>B.A. Boley, Columbia University, USA
>B. Gustafsson, Uppsala University, Sweden
>M.A. Ilgamov, Scientific Centre of Kazan, Russia
>S. Kobayashi, Kyoto University, Japan
>G. Kriegsmann, New Jersey Inst. of Tech., USA
>M. Lenoir, Ecole Nat. Sup. de Tech. Avancees, France
>E. Turkel, Tel-Aviv University, Israel
>
>All members of the Advisory Committee and six members of the Scientific
>Committee attended the symposium.
>
>
>Program
>----------
>
>The symposium was regarded by all as a resounding success. Disciplinary
>and semantic barriers were pushed aside as lively discussions accompanied
>the presentations. About two-thirds of the papers focused on the classical
>wave equation of acoustics, as this is the simplest governing equation of
>the types considered. However, three papers dealt with hydrodynamic
>surface waves, two with electromagnetic waves, three with elastodynamic
>waves, and four with waves in aerodynamics. Approximately two-thirds of
>the papers addressed steady-state problems, with the rest treating problems
>in the time domain.
>
>A key unifying aspect of the symposium was the creation of four working
>groups that labored in parallel to fomulate benchmark problems for
>evaluating computational boundaries. The working groups reviewed the
>papers presented each day, searching for benchmark candidates. Then they
>considered other possibilites and organized the ensemble into logical
>categories. At the end of the symposium, each group presented its
>benchmark candidates to the assembly of participants, which subsequently

>made a first cut at consolidating the benchmarks. The Scientific Program
>was as follows:
>
>MONDAY, 28 July: Ten Lecture Papers
>
>J.A. Bettess & P. Bettess, "New Mapped Wave Infinite Element and
>Diffraction of Waves by Elliptical Cylinders of Varying Aspect Ratio"
>
>B. Engquist & H.-K. Zhao, "Absorbing Boundary Conditions for Domain
>Decomposition"
>
>R.J. Astley, "Recent Advances in Applying Wave-Envelope Elements to
>Unbounded Wave Problems"
>
>J.P. Wolf & C. Song, "The Scaled Boundary Finite-Element Method: State of
>the Art
>
>P. Monk & F. Collino, "Optimizing the Perfectly Matched Layer"
>
>G.A. Athanassoulis & K.A. Belibassakis, "Water-Wave Green's Function for a
>3D Uneven-Bottom Problem with Different Depths x => Infinity and x =>
>-Infinity"
>
>S.I. Hariharan & T. Hagstrom, "A Systematic Approach for Constructing
>Asymptotic Boundary Conditions for Wave-Like Equations"
>
>L. Demkowicz and F. Ihlenburg, "Proof of Convergence for the Coupled
>Finite/Infinite Element Methods for Helmholtz Exterior Boundary-Value
>Problems"
>
>S.V. Tsynkov, "On the Combined Implementation of Global Boundary Conditions
>with Central Difference Multigrid Flow Solvers"
>
>R.L. Higdon, "Absorbing Boundary Conditions for Dispersive Waves"
>
>90-Minute Meetings of Four Benchmark Working-Groups
>
>TUESDAY, 29 July: Ten Lecture Papers
>
>D. Givoli & I. Patlashenko, "Optimal Local Artificial Boundary Conditions"
>
>I.C. Mathews & S. Newhouse, "A Comparison between Time and Frequency Domain
>Approaches for Rigid Body Scattering Problems"
>
>S.M. Grace & A.D. Pierce, "Reduction of the Complexity of the Intrinsically
>Nonlinear Problem of Aerodynamic Sound Generation in an Unbounded Domain"
>
>D.S. Burnett & R.L. Holford, "Multipole-Based 3-D Infinite Elements: An
>Ellipsoidal Acoustic Element and a Spherical Electromagnetic Element"
>
>J. Bielak, L.F. Kallivokas & R.C. MacCamy, "Absorbing Boundaries for
>Acoustic Wave Propagation Problems"
>
>G.A. Kriegsmann, "Acoustic and Electromagnetic Scattering by Large Resonant
>Structures"
>
>A.A. Oberai, M. Malhotra & P. Pinsky, "Implementing Highly Accurate
>Non-Reflecting Boundary Conditions for Large Scale Problems in Structural
>Acoustics"
>
>M.E. Hayder & H.L. Atkins, "Experience with PML Boundary Conditions in
>Fluid-Flow Computations"
>
>L. Gaul & Martin Schanz, "Calculation of Transient Response of Viscoelastic

>Unbounded Domains by Direct Boundary Element Method"
>
>I. Harari, "A Variational Formulation for Partitioned Exterior Problems"
>
>90-Minute Meetings of Four Benchmark Working-Groups
>
>WEDNESDAY, 30 July: Six Lecture Papers and Seven Poster Papers
>
>C.A. Felippa, "Coupling DAA-Boundary and Finite-Element Models"
>
>E. Watanabe & T. Utsunomiya, "A Response Analysis of Very Large Floating
>Structure under Airplane Landing by FEM and a Sponge Layer for the
>Unbounded Domain"
>
>J.-P. Coyette and L. Cremers, "A Practical Comparison of Finite Element and
>Boundary Element Formulations for Modeling Sound Radiation from Elastic
>Plates"
>
>T. Hagstrom, "Exact and High-Order Boundary Conditions in the Time Domain"
>
>K.R. Fyfe & A. Muradali, "Wave vs. Geometric Based Modeling of Barriers
>with Atmospheric Effects"
>
>T.L. Geers, "Singly and Doubly Asymptotic Computational Approximations"
>
>C.J. Damaren, "Approximation of Transient Hydrodynamics on Unbounded
>Domains Using Rational Functions"
>
>T.A. Driscoll & B. Fornberg, "Uses of the Berenger PML in Pseudospectral
>Methods for Maxwell's Equations"
>
>K. Gerdes, "Infinite Element Methods"
>
>M.N. Guddati & J.L. Tassoulas, "Transient Analysis of Wave Propagation in
>Unbounded Media: Space-Time Methods and Continued-Fraction Implementations"
>
>L.F. Kallivokas, J. Bielak & R.C. MacCamy, "Absorbing Boundary Conditions
>of Arbitrary Shape for the Three-Dimensional Wave Equation"
>
>A.J. Safjan, "Progress on Highly Accurate Non-Reflecting Boundary
>Conditions for Finite Element Simulations of Transient Acoustics Problems"
>
>C. Song & J.P. Wolf, "The Scaled Boundary Finite-Element Method: Future
>Developments"
>
>THURSDAY, 31 July
>
>90-Minute Meetings of Four Working-Groups
>30-Minute Preparation of Working-Group Presentations
>90-Minute Assembly Workshop (W-G Presentations)
>90-Minute Assembly Workshop (Benchmark Consolidation)
>
>
>Proceedings
>----------
>
>Authors brought with them 4-to-10-page abstracts, which were promptly
>copied and distributed to all participants. The symposium proceedings,
>which will be published by Kluwer Academic Publishers, is in final
>preparation. It begins with a lead article documenting the benchmark
>problems defined during the working-group meetings and assembly workshops.
>This is followed by 4-to-10-page abstracts of the thirty-three papers
>presented at the symposium.
>

>
>Financial Support
>----------
>
>The symposium participants greatly appreciate the financial support
>provided by the following organizations:
>
>Air Force Office of Scientific Resarch - $15,000
>International Association for Computational Mechanics - $1,500
>International Union of Theoretical and Applied Mechanics - $7,000
>Kluwer Academic Publishers - $600
>National Aeronautics and Space Administration - $15,000
>National Science Foundation - $10,000
>Office of Naval Research - $5,000
>University of Colorado - $2,000
>
>TOTAL - $56,100
>
>
>Participants
>----------
>
>R.J. Astley, University of Canterbury, NEW ZEALAND
>G.A. Athanassoulis, Nat'l Tech. Univ. of Athens, GREECE
>P. Bettess, University of Durham, UK
>J. Bielak, Carnegie Mellon University, USA
>D.S. Burnett, Bell Laboratories, Lucent Technologies, USA
>J.-P. Coyette, LMS-Numerical Technologies, BELGIUM
>C.J. Damaren, University of Canterbury, NEW ZEALAND
>L. Demkowicz, University of Texas, USA
>T.A. Driscoll, University of Colorado, USA
>C.A. Felippa, University of Colorado, USA
>K.R. Fyfe, University of Alberta, CANADA
>L. Gaul, University of Stuttgart, GERMANY
>T.L. Geers, University of Colorado, USA
>K. Gerdes, ETH Zurich, SWITZERLAND
>D. Givoli, Technion - Israel Inst. of Technology, ISRAEL
>S.M. Grace, Boston University, USA
>M.N. Guddati, University of Texas, USA
>B. Gustafsson, Uppsala University, SWEDEN
>T. Hagstrom, University of New Mexico, USA
>I. Harari, Tel-Aviv University, ISRAEL
>S.I. Hariharan, University of Akron, USA
>M.E. Hayder, NASA Langley Research Center, USA
>R.L. Higdon, Oregon State University, USA
>L.F. Kallivokas, Carnegie Mellon University, USA
>G.A. Kriegsmann, New Jersey Inst. of Technology, USA
>I.C. Mathews, Imperial College, UK
>P. Monk, University of Delaware, USA
>J.-C. Nedelec, Ecole Polytechnique, FRANCE
>A.A. Oberai, Stanford University, USA
>P.M. Pinsky, Stanford University, USA
>A.J. Safjan, University of Nebraska, USA
>C.L. Scandrett, Naval Postgraduate School, USA
>C. Song, Swiss Federal Inst. of Tech., SWITZERLAND
>S.V. Tsynkov, NASA Langley Research Center, USA
>E. Watanabe, Kyoto University, JAPAN
>J. P. Wolf, Swiss Federal Inst. of Tech., SWITZERLAND
>H.-K. Zhao, Stanford University, USA
>